Prevalence and Predictors of Anaemia in Pregnant Women Receiving Antenatal Care at Kilifi County Referral Hospital, Kenya

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Abstract

INTRODUCTION

Anaemia in pregnancy has been recognized as a public health problem of importance, especially in the developing world. This is due to related adverse outcomes among pregnant women and the unborn. However, the epidemiology of anaemia in pregnancy is unknown locally. This study sought to establish the prevalence and determinants of anaemia among pregnant women in a referral hospital in coastal Kenya.

MATERIALS AND METHODS

This was a cross-sectional study conducted among 191 pregnant women attending the antenatal clinic (ANC) at Kilifi County Referral Hospital. A pre-tested structured questionnaire was used to collect data and data was analysed using STATA version 15. Descriptive statistics were used to describe selected variables and logistic regression was used to determine the significance of factors associated with anaemia.

RESULTS

The prevalence of anaemia was 54% with factors associated with increased odds of anaemia being household size (AOR 1.27, 95%CI: 1.01-1.59, p=0.04), history of malaise and fever (AOR 9.69, 95%CI: 2.34-40.11, $P < 0.01$). Factors associated with reduced odds of anaemia were; food frequency (AOR 0.23, 95%CI: 0.1-0.51, $P < 0.01$), increased intake of vegetables and fruits (AOR 0.47, 95%CI: 0.34-0.47, $P < 0.001$), and red meat (AOR 0.39, 95%CI: 0.23-0.67, $P < 0.001$).

CONCLUSION

The relatively high prevalence of anaemia among pregnant women attending antenatal care suggests that anaemia is still a significant public health problem in Coastal Kenya. Increased household size and, a history of malaise and fever, were positively associated with anaemia while food frequency, vegetables, fruits and red meat intake were associated with a reduced likelihood of developing anaemia. Therefore, the ministries of health and other healthcare stakeholders at the county and national levels should enhance the supply of iron supplements at Kilifi County Hospital and other community-based health facilities targeted for pregnant women. Moreover, nurses and clinicians should intensify health education on anaemia in pregnancy from early antenatal clinic visits for pregnant mothers.

***Keywords**: Anaemia, Haemoglobin, Prevalence, Predictors, Pregnant Women*

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Introduction

Anaemia prevalence widely varies across the world, sub-Saharan Africa, and locally in Kenya. The global prevalence of anaemia among antenatal women range between 29.9%-36.8% [1]. In Asian countries, studies have reported diverse prevalences of anaemia among antenatal women such as 23.5% in China [2], 62.5% in Bangladesh [3], and 34.1% in Saudi Arabia [4]. In European countries, the prevalence were; 15.3% in France [5], 2.87% in Romania [6], and 17.7% in Croatia [7]. In the USA and Brazil, the prevalence of anaemia among pregnant women were 11.4% and 28.2% respectively [8,9]. In sub-Saharan Africa, a systematic review conducted recently established that anaemia among antenatal women was 41.7% [1]. In East African countries, the prevalence of anaemia among antenatal women has been reported as 41.82% [10]. A study done at Pumwani Maternity Hospital in Kenya established that prevalence of anemia among antenatal mothers was 57% in 2016 [11]. More recently, a national mapping of anemia prevalence in Kenya identified a 30.1% moderate and 16.6% severe anemia in 2019 [12].

Globally, studies have indicated that rural residence, low education levels, low income [13], age of 18-20 and above 35 years [14], and low monthly income [3] are key determinants of high anaemia prevalence among antenatal women. In sub-Saharan Africa the key determinants of anaemia among antenatal women are; low dietary diversity [15], illiteracy [10], low family income, HIV seropositivity, hookworm infection [16], and malaria infection [17]. In Kenya, failure to take Iron Folic Acid supplements, age above 31 years [11], and residing in malaria endemic zones [12] have been linked to a higher likelihood of being anaemic among antenatal women. Despite anaemia being widely recognized as a public health problem of importance, its epidemiology remains scanty in this setting. This study sought to establish the prevalence and determinants of anaemia among pregnant women in a referral hospital in coastal Kenya. The findings of this study will inform the ministry of health and other stakeholders on policy improvement and best management of anaemia among pregnant women in coastal Kenya.

Methodology

Study setting

The study was conducted at Kilifi County Hospital (KCH), a level four Government facility with a 172-bed capacity in coastal Kenya. The facility provides outpatient and inpatient services, maternal and child health care comprising family planning, and antenatal care. Three nurses and two nutritionists usually manage the antenatal clinic.

Study design and participants

A hospital-based cross-sectional study was conducted between 22nd August 2022 and 16th September 2022. The study population included all pregnant women attending ANC at Kilifi County Hospital.

Sample size determination

The sample size was determined by using a single population proportion formula [18] $n = Z^2pq/d^2$) at a 95% CI, a 40% proportion of antenatal anaemia in Kenya [19], and an absolute precision of 0.05, resulting in 368 participants. However, since the population during the study period was below 10,000, sample size adjustment was made using the formula $nf= n/ (1+ (n/N))$, resulting in 191 subjects. Where: nf = The desired sample size (when the study population is less than 10,000), N = Total population (around 400 antenatal women), n = The desired sample size (when the study population is over 10,000), which is 368.

Sampling method

Pregnant women attending ANC at the Kilifi County Referral Hospital were randomly selected. A 4-week ANC attendance analysis estimated that 20 pregnant women visit the clinic daily. A systematic sampling method was used to select study participants. 400 pregnant women divided by minimum sample size (191) resulting in a sampling interval of 2. The first participant was chosen randomly. Every second subsequent pregnant woman was recruited until the desired sample size was reached. The research assistants ensured no double recruitment by verifying prior

ANC visits and study participation during data collection.

Data collection

Pretesting of the questionnaire at the ANC unit of Malindi Sub-County Hospital before the main data collection phase involved the administration of the questionnaire to a random sample of 30 individuals, representing 15% of the total sample size of 191 women. In the actual study, after the clients had routine ANC services, the ladies were requested to participate in the study after the informed consent process. The questionnaire was then administered by trained research assistants in a private room to maintain confidentiality to collect data on demographic and socio-economic characteristics, obstetric and medical history, ANC visits, iron and folic supplementation, and dietary habits. Data on haemoglobin concentration was abstracted from the participant's ANC booklets.

Data analyses

Data were analysed using STATA Version 15 [20] and Jeffreys's Amazing Statistics Program (JASP) [21]. Descriptive statistics such as frequency, percentage, median, and interquartile range (IQR) were used to describe selected variables. Pearson's chi-square and Fisher's exact tests were computed to find an association between categorical independent variables and anaemia. Wilcoxon Rank-Sum Test and the Kruskal-Wallis Test were used to compare medians. Spearman's rank correlation was used to measure the strength and direction of association between continuous independent variables and haemoglobin levels. The prevalence of anaemia was reported as a percentage with a 95% CI. Logistic regression was used to identify independent factors associated with anaemia. Different bi-variable regression models were performed for each independent variable. Variables with a p-value of 0.25 or below in bi-variable analysis were subjected to a multivariable analysis. A P-value of below 0.05 was considered statistically significant.

Ethical and logistical considerations

The study was approved by the Ethical Review Committee of Pwani University (ERC/BSc/011/2022). The Kenyan National Commission for Science, Technology, and Innovation issued additional permits and licenses for the study (398785). Before data collection, written informed consent was obtained from all study participants.

Results

Participants' characteristics

The one hundred twenty-one participants (63.3%) were aged 20 to 29, Eighty-five (44.5%) had post-primary education, 152 (79.6%) were employed temporarily, 87 (46%) earned between two and five USD daily, 152, (79.6%) used tap water, 75% of households had three or more adults living with them, 121 (63.4%) were multiparous, and 93 (48.7%) were in their second trimester. Additional characteristics, such as clinical, dietary, and prevention services, are shown in Table 1.

Table 2 shows haemoglobin levels based on anaemia-prevention services utilized. Iron and folic acid users had increased haemoglobin levels (median=11.25, IQR=10.10-12.10) compared to non-users (median=10.00, IQR=9.00-11.10), $P < 0.001$. Those who received sulfadoxine-pyrimethamine prophylaxis and deworming services also had higher haemoglobin levels than those who did not ($P < 0.001$) (Table 2).

Figure 2 shows the correlation between participants' dietary habits and haemoglobin levels. Both the frequency of meals per day and the frequency of red meat consumption per week had significant moderate positive correlations with haemoglobin levels (Figures 2. A and C, respectively), whereas the frequency of daily consumption of vegetables and fruits had a strong positive correlation with haemoglobin levels (rho=0.7, $P < 0.001$) (Figure 2. B).

Table 1:
Study Participants' Characteristics

Variables		**Total (N=191), %**
Sociodemographic characteristics		
Age	Below 20 years	20(10.5)
	20-29 year	121(63.3)
	Above 30 years	50(26.2)
Education Level	Informal	38(19.9)
	Primary	68(35.6)
	Post-primary	85(44.5)
Employment Status	Temporary	152(79.6)
	Permanent	39(20.4)
Daily income (USD)	<2	76(39.8)
	2-5	87(45.6)
	5-10	18(9.4)
	>10	10(5.2)
Source of Drinking Water	Tap	152(79.6)
	Other sources	39(20.4)
Household Size	Median (IQR)	4(3-6)
Obstetric related characteristics		
Parity	Primiparous	70(36.6)
	Multiparous	121(63.4)
Trimester	First	17(8.9)
	Second	93(48.7)
	Third	81(42.4)
Clinical characteristics		
HB level	Median (IQR)	10.8(9.6-11.8)
Anemia Status	No	86(45.03)
	Yes	105(54.97)
Pallor	No	127(66.49)
	Yes	64(33.51)
Splenomegaly	No	185(96.86)
	Yes	6(3.14)
Edema	No	188(98.43)
	Yes	3(1.57)
Temperature	Median (IQR)	36.4(36-36.9)
Hospitalization	No	187(97.91)
	Yes	4(2.09)
History of malaise and fever	No	141(73.82)
	Yes	50(26.18)
Dietary characteristics		
Meals per day	Median (IQR)	3(3-4)
Vegetables/fruits per day	Median (IQR)	4(3-5)
Red meat per week	Median (IQR)	1(1-2)
Prevention services		
Iron Folic Acid Supplementation	No	79(41.36)
	Yes	112(58.64)
Sulfadoxine-Pyrimethamine Prophylaxis	No	102(53.4)
	Yes	89(46.6)
Deworming	No	107(56.02)
	Yes	84(43.98)

Prevalence of anaemia

Table 3 shows the prevalence of anaemia across various categories of factors. Overall, 54% (95% CI: 48%-62%) of the 191 participants were anaemic. Anaemia prevalence was bimodal, with peaks in those younger than 20 (65%, 95% CI: 42%-83%) and older than 30 (66%, 95% CI: 52%-77%). Compared to other levels of education, those with informal education had the highest prevalence of anaemia. Those with less than two USD per day income and those in temporary employment had the highest prevalence of anaemia in their respective groups (Table 3).

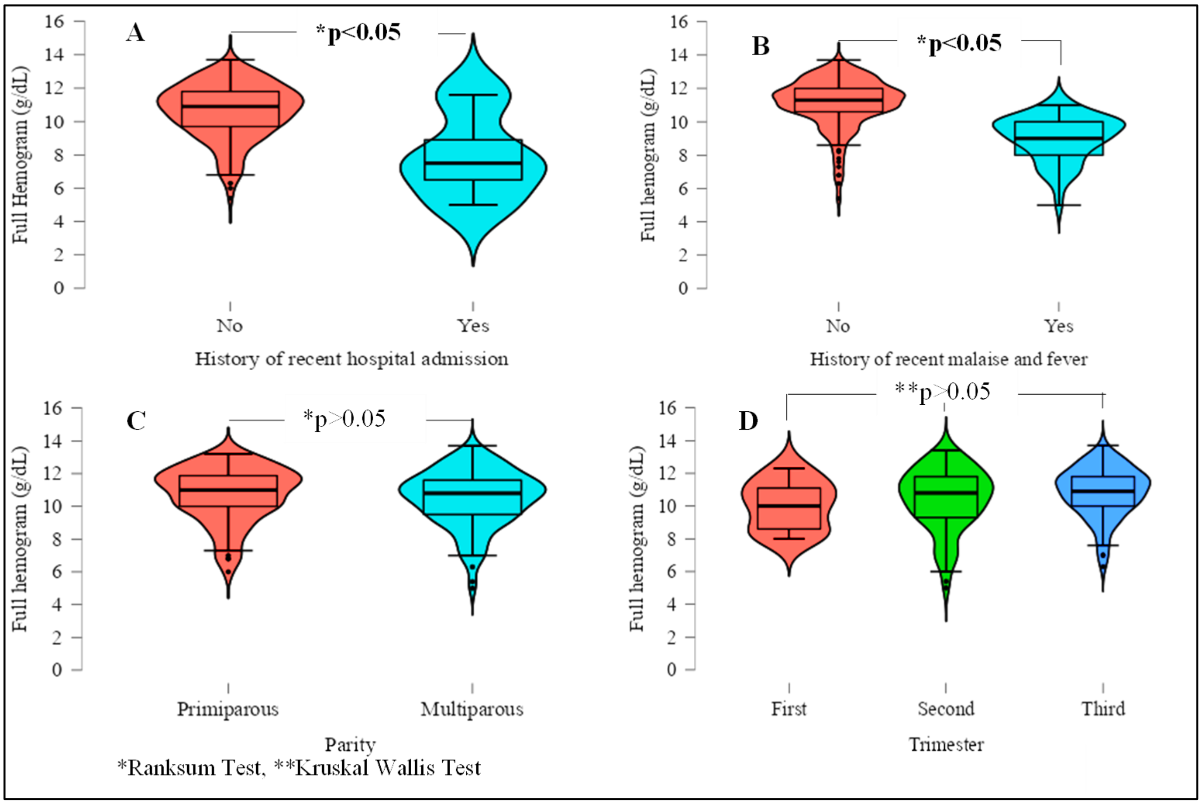

Figure 1:
Level of Haemoglobin among Participants

Table 2:
Haemoglobin Levels Based On Anaemia-Prevention Services Utilized

Prevention services		Full Hemogram (g/dL) Median (IQR)	P-Value
Iron Folic Acid	No	10.00(9.00-11.10)	<0.000
	Yes	11.25(10.10-12.10)	
Sulfadoxine-Pyrimethamine	No	10.00(9.00-11.47)	<0.000
	Yes	11.30(10.30-12.30)	
Deworming	No	10.20(9.00-11.60)	<0.000
	Yes	11.35(10.42-11.90)	

Anaemia status of participant by categories

Table 4 shows the distribution of anaemia in various participant categories. Anaemia prevalence did not differ significantly by age group. Anaemia prevalence varied substantially by education level, daily income, source of drinking water, and household size. Participants with informal education comprised significantly more anaemic participants (28.57%) than those without anaemia (9.3%). Regarding clinical factors, those with a history of malaise and fever comprised a larger proportion of anaemia than no anaemia. Those with a history of recent hospital admission were more in the anaemia group than the no-anaemia group even though this was statistically insignificant (*P*=0.629). Compared to those without anaemia, those with anaemia reported infrequent intake of meals per day (median=3 versus 4, $P < 0.001$), vegetables and fruits per day (median=3 versus 5, $P < 0.001$), and red meat per week (median=1 versus 2, $P < 0.001$), Pertaining prevention services, those using IFAS, SP prophylaxis and deworming services comprised significantly lesser proportion of anaemia compared to no anaemia (Table 4).

Factors associated with anaemia

In the bivariable analysis (Table 5), eleven factors were associated with a lower risk of anaemia, while three factors were associated with an increased risk. Those with primary and secondary education had a 62% (OR=0.38, 95% CI: 0.15-0.95, p=0.004) and 81% (OR=0.19, 95% CI: 0.08-0.46, $P < 0.001$) lower odds of anaemia, respectively, compared to those with informal education. Anaemia odds were reduced by 75% for those with a daily income of two USD to five USD, 89% for those with a daily income of five USD to 10 USD, and 97% for those with a daily income greater than 10 USD. Increased meal frequency, vegetable and fruit consumption, red meat consumption, and use of IFAS, SP prophylaxis, and deworming services were also significantly associated with lower odds of anaemia (Table 5).

Anaemia was more than four times more likely in those who drank water from other sources than in those who drank tap water (OR=4.08, 95%CI: 1.79-9.46, $P < 0.001$). Anaemia was significantly associated with increasing household size (OR = 1.5, 95% CI: = 1.28-1.75, $P < 0.01$).

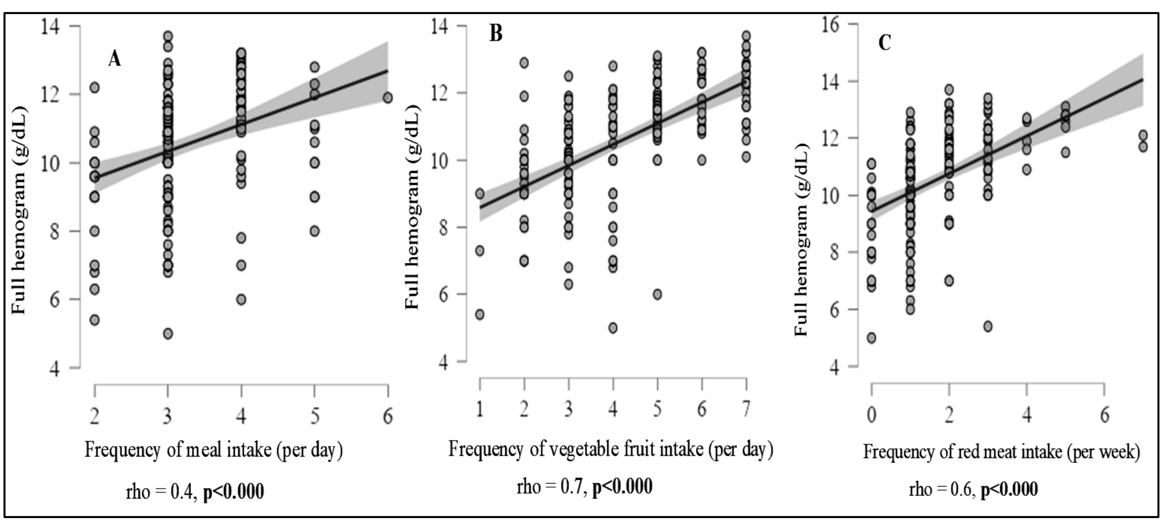

Figure 2:
Correlation Between Participants' Dietary Habits and Haemoglobin Levels.

Those who reported a recent history of malaise and fever were nearly sixteen times more likely to be anaemic than those who did not (OR 15.98, 95%CI: 5.45-46.8). After adjusting for covariables, only five factors remained significantly associated with anaemia in the multivariable analysis (Table 5). Anaemia odds were significantly associated with increased household size (AOR 1.27, 95%CI: 1.01-1.59, p=0.04) and history of malaise and fever (AOR 9.69, 95% CI: 2.34-40.11, *P* < 0.01). Reduce the risk of anaemia was associated with increased consumption of meals (AOR 0.23, 95%CI: 0.1-0.51, *P* < 0.01), vegetables and fruits (AOR 0.47, 95%CI: 0.34-0.47, *P* < 0.001), and red meat (AOR 0.39, 95%CI: 0.23-0.67, *P* < 0.001).

Table 3:
Distribution of Anaemia in Various Participant Categories

Factors		**Anaemia Status**		
Sociodemographic Factors		**Anaemia**	**No Anaemia**	***P* - Value**
Age	Below 20 years	13(12.38)	7(8.14)	0.076
	20-29 year	59(56.19)	62(72.09)	
	Above 30 years	33(31.43)	17(19.77)	
Education	Informal	30(28.57)	8(9.3)	<0.001
	Primary	40(38.1)	28(32.56)	
	Post-primary	35(33.33)	50(58.14)	
Daily income (USD)	<2	59(56.19)	17(19.77)	<0.001
	2-5	40(38.1)	47(54.65)	
	5-10	5(4.76)	13(15.12)	
	>10	1(0.95)	9(10.47)	
Employment status	Temporary	94(89.52)	58(67.44)	<0.001
	Permanent	11(10.48)	28(32.56)	
Source of drinking water	Tap	74(70.48)	78(90.7)	<0.001
	Other sources	31(29.52)	8(9.3)	
HH size	Median (IQR)	5(4-8)	3(2-4)	<0.001
Pregnancy-Related Factors				
Parity	Primiparous	34(32.38)	36(41.86)	0.176
	Multiparous	71(67.62)	50(58.14)	
Trimester	First	74(70.48)	6(6.98)	0.491
	Second	26(24.76)	40(46.51)	
	Third	5(4.76)	40(46.51)	
Clinical Factors				
Hospitalization	No	102(97.14)	85(98.84)	0.629
	Yes	3(2.86)	1(1.16)	
History of malaise and fever	No	59(56.19)	82(95.35)	<0.001
	Yes	46(43.81)	4(4.65)	
Dietary Factors				
Meal per day		3(3-3)	4(3-4)	<0.001
Vegetables/fruits per day		3(2-4)	5(4-6)	<0.001
Red meat per week		1(1-1)	2(1-3)	<0.001
Prevention services				
Iron and Folic Acid	No	56(53.33)	23(26.74)	<0.001
	Yes	49(46.67)	63(73.26)	
Sulfadoxine-Pyrimethamine	No	68(64.76)	34(39.53)	0.001
	Yes	37(35.24)	52(60.47)	
Deworming	No	70(66.67)	37(43.02)	0.001

Discussion

The study established a prevalence of 54% anaemia among the study participants, suggesting that anaemia in pregnancy is still a significant public health problem in the region [1]. This confirms findings reported Pakistan [13], and Northern Ghana [22]. These similarities suggest shared risk factors in the different regions [12]. In contrast, the findings are higher than global estimates of 36.8% [1], and 41.82% in East Africa [10]. The difference in prevalence may be explained by existing disparities in healthcare access, and socio-economic or medical factors associated with anaemia in pregnancy. For instance, malaria — endemic in Coastal Kenya — is associated with anaemia [12]. These finding demonstrates a need for integrated and focused interventions including nutrition and malarial control programs among pregnant women.

Table 4:
Logistic Regression Model for Factors Associated with Anaemia

Determinants		Bivariable analysis		Multivariable analysis	
		Odds Ratio(95%CI)	**P-value**	**Adjusted Odds Ratio(95%CI)**	**P-value**
Sociodemographic Factors					
Age	Below 20 years	1 (Reference)		1 (Reference)	
	20-29 year	0.51(0.19 - 1.37)	0.18	1.11(0.16 - 7.81)	0.92
	Above 30 years	1.05(0.35 - 3.11)	0.94	1.72(0.16-18.09)	0.65
Education	Informal	1 (Reference)		1 (Reference)	
	Primary	0.38(0.15 - 0.95)	0.04	0.73(0.13-4.11)	0.72
	Post-primary	0.19(0.08 - 0.46)	<0.01	0.84(0.14-5.01)	0.84
Daily income (USD)	<2	1 (Reference)		1 (Reference)	
	2-5	0.25(0.12 - 0.49)	<0.01	0.55(0.16-1.86)	0.33
	5-10	0.11(0.03 - 0.35)	<0.01	0.86(0.07-10.43)	0.91
	>10	0.03(0 - 0.27)	<0.01	0.14(0.01-2.37)	0.17
Source of drinking water	Tap	1 (Reference)		1 (Reference)	
	Other sources	4.08(1.76 - 9.46)	<0.01	1.48(0.34-6.33)	0.60
HH size		1.5(1.28 - 1.75)	<0.01	1.22(0.96 - 1.55)	0.11
Pregnancy-Related Factors					
Parity	Primiparous	1 (Reference)		1 (Reference)	
	Multiparous	1.5(0.83 - 2.72)	0.18	1.01(0.27-3.81)	0.98
Trimester	First	1 (Reference)		1 (Reference)	
	Second	0.72(0.25 - 2.12)	0.55	*	
	Third	0.56(0.19 - 1.66)	0.29	*	
Clinical Factors					
Hospitalization		2.5(0.26 - 24.48)	0.43	*	
History of malaise and fever		15.98(5.45 - 46.83)	<0.01	11.53(2.28 – 58.23)	<0.01
Dietary Factors					
Meal per day		0.29(0.17 - 0.47)	<0.01	0.22(0.09 - 0.54)	<0.01
Vegetables/fruits per day		0.38(0.29 - 0.5)	<0.01	0.46(0.32 - 0.67)	<0.01
Red meat per week		0.34(0.23 - 0.49)	<0.01	0.44(0.25 - 0.76)	<0.01
Preventive factors					
Iron and Folic Acid		0.32(0.17 - 0.59)	<0.01	0.82(0.18-3.77)	0.80
Sulfadoxine-Pyrimethamine		0.36(0.2 - 0.64)	<0.01	0.48(0.11-2.21)	0.35
Deworming		0.38(0.21 - 0.68)	<0.01	0.49(0.17-1.39)	0.49

*Variable not carried forward to multivariable analysis

The study revealed lower haemoglobin levels among those who had malaise and fever and those with a history of a recent hospitalization. To affirm this, the multivariable analysis established that the risk of anaemia was significantly higher among those with malaise and fever (AOR=11.53). The presence of malaise and fever may indicate underlying conditions predisposing anaemia [23]. Similar to the current study, past studies have linked hospitalization with anaemia [24]. These findings emphasize the importance screening recently hospitalized pregnant women for anaemia, particularly those with fever and malaise, to ensure timely diagnosis and management.

It was established that pregnant women receiving iron and folic acid supplementation, sulfadoxine-pyrimethamine prophylaxis, and deworming had higher haemoglobin levels than those who did not. As a result, pregnant women not using the above anaemia prevention services constituted a higher proportion of those with anaemia. It is understood that iron folic supplementation helps replenish depleted iron stores in the body of pregnant women [25]. Sulfadoxine pyrimethamine prophylaxis helps reduce malaria incidence among pregnant women [26]. Malaria parasites are known to cause haemolysis of red blood cells leading to anaemia among pregnant women [27]. Thus, it is expected that haemoglobin levels will be higher among pregnant women using sulfadoxine-pyrimethamine prophylaxis than those who do not. Deworming helps eliminate helminths known to cause iron loss through intestinal bleeding [28], leading to anaemia in pregnant women [29]. Conclusively, the above findings underscore the need for enhanced iron and folic acid supplementation, sulfadoxine-pyrimethamine prophylaxis, and deworming among pregnant women to help reduce the high prevalence of anaemia among them in Coastal Kenya.

Consumption of red meat, vegetables, and fruits had a positive correlation with haemoglobin levels, as well as reduced risk of anaemia in the current study. Proportion of pregnant women with anaemia was higher among those with low dietary diversity. Additionally, reduced risk of anaemia was significantly associated with increased consumption of vegetables, fruits, and red meat. Diverse diet helps replenish iron which is likely to be depleted due to high nutritional demands during pregnancy [30]. Red meat, vegetables, and fruits consumption is known to prevent anaemia among pregnant [16,30]. These findings reiterate the need for extensive nutritional sensitization on dietary diversification among pregnant women.

Limitations

This study was cross-sectional; hence difficult to establish causal effect relationships between the risk factors discussed and the outcome of anaemia among pregnant women. The study may have suffered social desirability bias, with the participants giving responses that they felt were appropriate to the study, contrary to their real-life experiences. The fact that this was a hospital-based study may mean that a lot was missed from pregnant women who did not attend the antenatal care clinic; thus, the findings may not be generalizable to the larger Coastal region of Kenya. Lastly, due to time constraints, we used a small sample size that was accessible during the data collection period. We therefore recommend future community-based longitudinal studies with larger sample sizes.

Conclusion

The prevalence of anaemia among pregnant women attending antenatal care in Kilifi County Hospital is 54%. This shows that anaemia in pregnancy is still a significant public health problem in coastal Kenya which needs close attention from key stakeholders. Increased household size, increased food frequency, red meat, vegetables, and fruits, as well as a history of malaise and fever, are determinants of anaemia in pregnancy in Coastal Kenya. Therefore, the Ministry of Health should enhance nutritional support and sensitization relevant to reducing anaemia in pregnancy, emphasizing women with low income and informal education levels. This would help alleviate the high prevalence of anaemia and reduce the potential adverse outcomes.

What is already known on this topic

- The most recent national prevalence of anaemia is estimated to be 40%.
- Anaemia in pregnancy if not well managed can lead to adverse outcomes for the mother and the unborn.

Contributions of this study

- The current prevalence of anaemia among pregnant women attending antenatal care at Kilifi County referral hospital in coastal Kenya is 54%.
- Increased household risk and a recent history of malaise and fever are risk factors for anaemia in pregnancy.
- Increased consumption of meals, red meat, vegetables and fruits has the potential to reduce the risk of anaemia among pregnant women.

Competing interests. The authors declare no competing interest.

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Authors' contributions. Berrick Otieno was involved in conceptualization, investigation, methodology, software, data curation, writing (original draft preparation), formal analysis, and visualization. Salwa Elmawi was involved in conceptualization, investigation, resources, and methodology. Cyrus Mutie performed the writing of the original draft, validation, & and visualization. Mwaswere Juma performed writing (review and editing) and supervised the study. Makorani Y'Dhidha-a-Mjidho and Isaack Kyalo performed the writing (review and editing) of the manuscript. Osman Abdullahi performed conceptualization, writing (review and editing), and supervision of the study. All authors read, agreed, and approved the final draft.

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